being managed so as to produce at will any rate of current down to almost an insensible breathing. I prefer it, also, in consequence of its great capability of management. When I state that in some experiments which I made ten years since, I raised a column of mercury nine inches by the force of the current of air produced by it, the Committee may see from that fact, that it is capable of producing a force which never can be required for ventilation. M. Arago, in some experiments within the last few months, has raised, by a current of air thus produced, a column of mercury 15 inches. Therefore these facts prove that we have abundant power so as to overcome every opposition arising from wire-drawing or other resistance, and to compel air to pass with uniformity wherever it may be necessary. It is simple in application, and its economy great, though that is not of so much consequence as the former; it is capable of being passed easily and independently to any part of the building separately. You may act by this principle upon groups of rooms, or upon single rooms, or anywhere where it may be convenient; by that means, you prevent the necessity of cutting up the building, or the making of large communications. Another advantage which it will produce, and which though last may not be the least, is, that it is capable of passing a sufficient quantity of air, as much as can be required to produce ventilation, through small passages; which passages may be secured against the communication of flame, in case of fire, on the principle of the safety-lamp. This is a circumstance of great importance where a building is to be made fire-proof. Supposing there are several rooms connected together by ventilating flues, all would be rendered safe and perfectly independent of each other as to fire, by the intervention of diaphragms of wire gauze, upon the principle of Sir Humphrey Davy's safety lamp. Wire gauze cannot be introduced unless you have great command of power, because you offer by it a strangulation difficulty in the passage of air, which cannot be overcome by the ordinary means of ventilation.

You are aware that Dr. Reid has a plan for collecting the smoke of every fire in the building, and conveying it all through one shaft?—I have heard so.

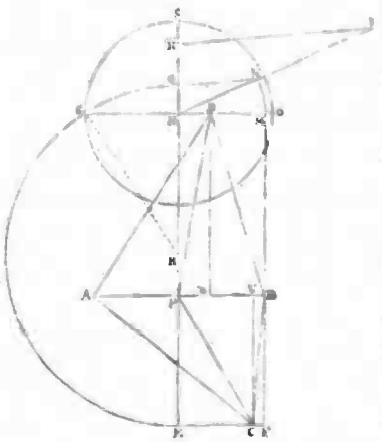
Do you believe that that can be done?—I think it is very difficult.

SOLUTION OF THE QUESTION ON THE CONVERSION OF AREAS.

It is gratifying to find that subjects of a practical and useful character are duly appreciated by the readers of THE BUILDER; it appears that they have had their attention directed to the geometrical *conversion of surfaces*, an example of which was given in No. 168 of the journal, in reference to the development and conversion of the convex surfaces of the right cylinder and cone. The theory, when taken in its whole extent, is a most elegant and important one, and by its aid many thousand practical questions may be resolved with the greatest facility, the solution of which by other methods would be a matter of no easy accomplishment. In fact, the doctrine of the conversion of figures bears a similar relation to the common processes of practical geometry, as that which the theory of fluxions or the differential and integral calculus bears to common algebra. The question proposed in No. 172, by a correspondent who signs himself "A Builder," affords a striking illustration of the utility of the principle; and there can be no doubt but he is aware of the practical advantages to be derived from such a system, and it may be satisfactory for him and other operatives who take an interest in enquiries of this nature, to know, that a full development of the subject, with all its most useful and important practical appliances, will shortly meet the public eye. But to the question.

In examining the proposed data, it appears that there is one side in each aperture of the same length, viz., twenty-eight inches; it will therefore be the most convenient mode of delineation to refer both the triangles to that side as a common base, and so to arrange them that one may lie on each side of it; by this disposition of the given triangles, they are at once reduced to the equivalent quadrilateral figure, ACBD. Through C and D, the vertices of the triangles constituted upon the common base AB, draw the straight lines EF and GO respectively parallel to AB and to one another. Bisect AB in the point P, and through P the middle, and B the extremity of the bisected line, draw EN and FM respectively perpendicular to AB, and meeting the parallels EF and NM in the points E, N and F, M, thereby constituting the rectangular parallelograms EFBP and PBMN, making together the whole rectangle EFMN equal to the given triangular apertures ABC and ABD.

Produce EN, the side of the rectangular parallelogram EFMN, directly forward to any convenient distance, and from the point N in that side draw the straight line NI in any direction at pleasure; then, on NI set off the number 7·1, or some multiple or submultiple of it from a scale of equal parts of any magnitude whatever, and on EN produced towards S, set off NR from the same scale of equal parts, making it equal to the number 2·26, or to the same multiple or submultiple of it that NI is of 7·1. Make NK equal to NM the



other side of the parallelogram NMFE, and join IR; then, through the point K in the straight line NI and parallel to IR draw KQ, meeting EN produced in Q, and NQ will be the diameter of a circle whose circumference is NM. At this stage of the process the solution becomes assimilated to that of the cylinder in No. 168 of THE BUILDER, for the rectangular parallelogram ENMF may now be considered as the development of a cylindric surface, of which the length is EN, and the diameter NQ, the circumference of the end being equal to NM.

Bisect EQ in H, and on H as a centre describe the semi-circle EGQ, meeting MN produced in G; then is NG the radius of the circle required; therefore, upon N as a centre with the radius NG thus determined, describe the circle GSO, and it will be equal in area to the given apertures or triangles ABC and ABD.

Demonstration.—From C and D, the vertices of the triangles to the middle of the common base at P, draw the straight lines CP and DP; then, because AB is bisected in P, the triangles ACP and BCP are equal, for they are upon equal bases, AP and BP, and between the same parallels EF and AB; therefore, the whole triangle ABC is double of the triangle BCP; but the rectangle BFEP is double of the triangle BCP, for when a parallelogram and a triangle have the same base, and are between the same parallels, the parallelogram is double of the triangle; consequently, the parallelogram BFEP is equal to the whole triangle ABC, for things that are double of the same thing are equal to one another.

Again; since, as before, AP is equal to BP, the triangles ADP and BDP are equal, for they are upon equal bases, AP and BP, and between the same parallels, AB and NM; therefore the whole triangle ADB is double of the triangle BDP; but the rectangle BMNP is double of the triangle BDP; for when a parallelogram and a triangle have the same base, and are between the same parallels, the parallelogram is double of the triangle; consequently, the parallelogram BMNP is equal to the whole triangle ADB, for things that are double of the same thing are equal to one another; wherefore, the whole rectangular parallelogram EFMN is equal to both the triangles ACB and ADB.

Because the straight lines IR and KQ are parallel by the construction, the triangles NIR and NKQ are similar, and their corresponding sides proportional; therefore we have, NI : IR : : NK : NQ; that is, 7·1 : 2·26 : : (NM=14) : $NQ^* = \frac{2\cdot26\times14}{7\cdot1} =$ 4·4563380 inches, true to the last place of decimals. Then, because NQ is the diameter of a right cylinder, of which the circumference is NM, and development ENMF, the straight line EQ is equal to the length of the cylinder, and the diameter of its end extended in the same straight line; and it was shown by a legitimate and rigorous investigation applied to the cylinder, in No. 168, that the radius of a circle of equal area to the convex surface, is a mean proportional between the diameter of the cylinder and its length; but NG, by the property of the circle, is a mean proportional between EN and NQ, the one being the length, and the other the diameter of the cylinder; consequently, the circle GSO, which is described with the radius NG, is equal to the development of the cylindric surface, or to the rectangle ENMF; but we have shown that the rectangle ENMF is equal to both the triangles ACB and ADB; therefore, the circle GSO is equal to the same triangles, and GO is the diameter required.

The above is the solution of the question as required by the proposer; we should, however, consider the process as being incomplete, were we not to accompany it with the arithmetical solution also, both as a criterion of comparison, and for a test of its accuracy; this is necessary, since the principle employed for the conversion of the cylindric surface alluded to above, has been impugned by at least one reader of THE BUILDER; and he must be given to understand that it is no less an authority than Archimedes himself that he is endeavouring to overthrow; for he has beautifully demonstrated the truth of the same principle, in his treatise on the sphere and cylinder; and it is scarcely to be expected, that applying a pair of compasses to a wood-cut on a printed sheet, and comparing the measurements with a carpenter's common rule, will be competent to overthrow the demonstrations of that PRINCE OF MATHEMATICIANS; yet, strange to say, such have been the means employed for that purpose.

By the common rules of mensuration, the area of a plane triangle, when three sides are given, is found by *multiplying altogether the half sum of the sides, and the differences between this half sum and each of the sides, and extracting the square root of the product*: or it is found by *drawing the base into the perpendicular, and taking half the product*; and since it is necessary to know the sum of the perpendiculars, or EN, the length of the rectangle ENMF, in order to compare the result with that obtained by the foregoing solution, we shall perform the process in both ways, as the one will serve as a check upon the other, and avoid the liability to error in numerical operations.

For the area of the triangle ACB, the process by the first method, is

Sum of the sides, 34+28+22=84

Half sum of the sides, $\frac{84}{2}$=42.. log. 1·6232439

Differences .....
42—34= 8.. log. 0·9030900
42—28=14.. log. 1·1461280
42—22=20.. log. 1·3010300

Sum of logs. 4·9734919

Area of the triangle ACB=306·7227 square inches. Half sum of logs. 2·4867459

For the area of the triangle ADB, the process, by the first method, is

Sum of the sides, 36+32+28=96

Half sum of the sides, $\frac{96}{2}$=48.. log. 1·6812412

Differences .....
48—36=12.. log. 1·0791812
48—32=16.. log. 1·2041200
48—28=20.. log. 1·3010300

Sum of logs. 5·2655724

Area of the triangle ADB=429·325 square inches. Half sum of logs. 2·6327862

* It may be proper to state, for the greater satisfaction of the reader, that the number 2·26, used in the analogy, is the diameter of a circle whose circumference is 7·1, numbers which express the ratio true to the sixth place of decimals, and differing by less than 2 in the seventh place, and are therefore more than sufficiently accurate for every purpose.

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